Baseline instruments planned for the GOES-R series

James J. Gurka
NOAA/ NESDIS, Office of Systems Development,
Silver Spring, Maryland, U.S.A.

Timothy J. Schmit
NOAA/ NESDIS, Office of Research and Applications,
Madison, Wisconsin, U.S.A.

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GOES R Instruments

- Advanced Baseline Imager (ABI)
- Hyperspectral Environmental Suite (HES)
  - Disk Sounding
  - Severe Weather Mesoscale
  - Coastal Imager
- Geostationary Lightning Mapper (GLM)
- Solar Imaging Suite (SIS)
- Space Environment In Situ Suite (SEISS)

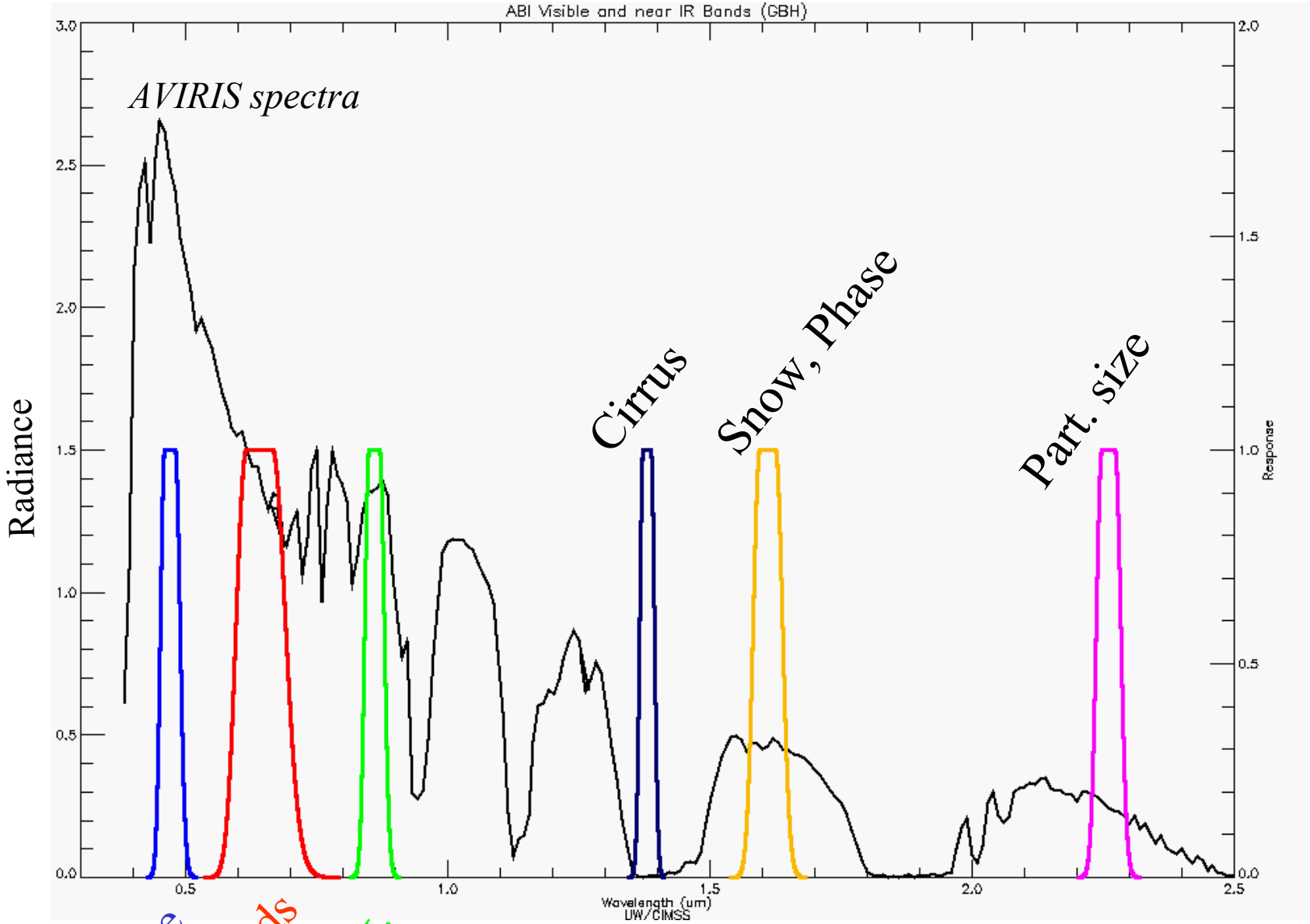
SYSTEM IMPROVEMENTS

GOES-I/P Instruments	GOES-R Notional Baseline
Imager **5 Channels**	**Advanced Baseline Imager (ABI)** **16 Channels At Higher Spatial And Temporal Resolution**
Multispectral Sounder **19 Sounding Bands** **N/A**	**Hyperspectral Environmental Suite (HES)** **1500 Sounding Bands** **HiRes Imaging Bands**
Solar X-Ray Imager **Space Environmental Monitor**	**Solar Imaging Suite (SIS)** **Space Environmental In-Situ Suite (SEISS)**
N/A	**Geostationary Lightning Mapper (GLM)**

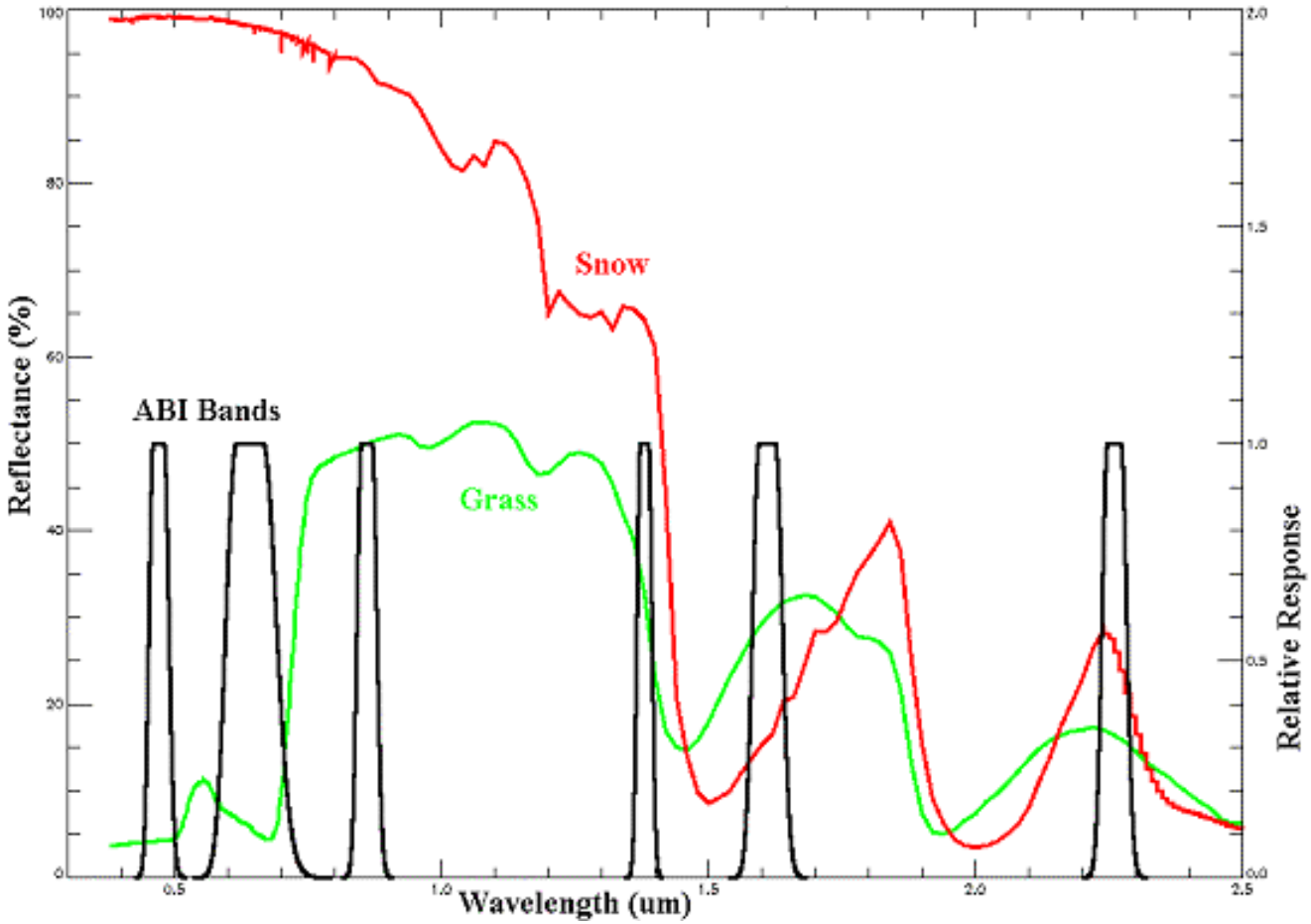
The Advanced Baseline Imager:

	ABI	Current
Spectral Coverage		
	16 bands	5 bands
Spatial resolution		
0.64 μm Visible	0.5 km	Approx. 1 km
Other Visible/nearIR	1.0 km	n/a
Bands (>2 μm)	2 km	Approx. 4 km
Spatial coverage		
Full disk	4 per hour	Every 3 hours
CONUS	12 per hour	~4 per hour
Visible		
On-orbit calibration	Yes	No

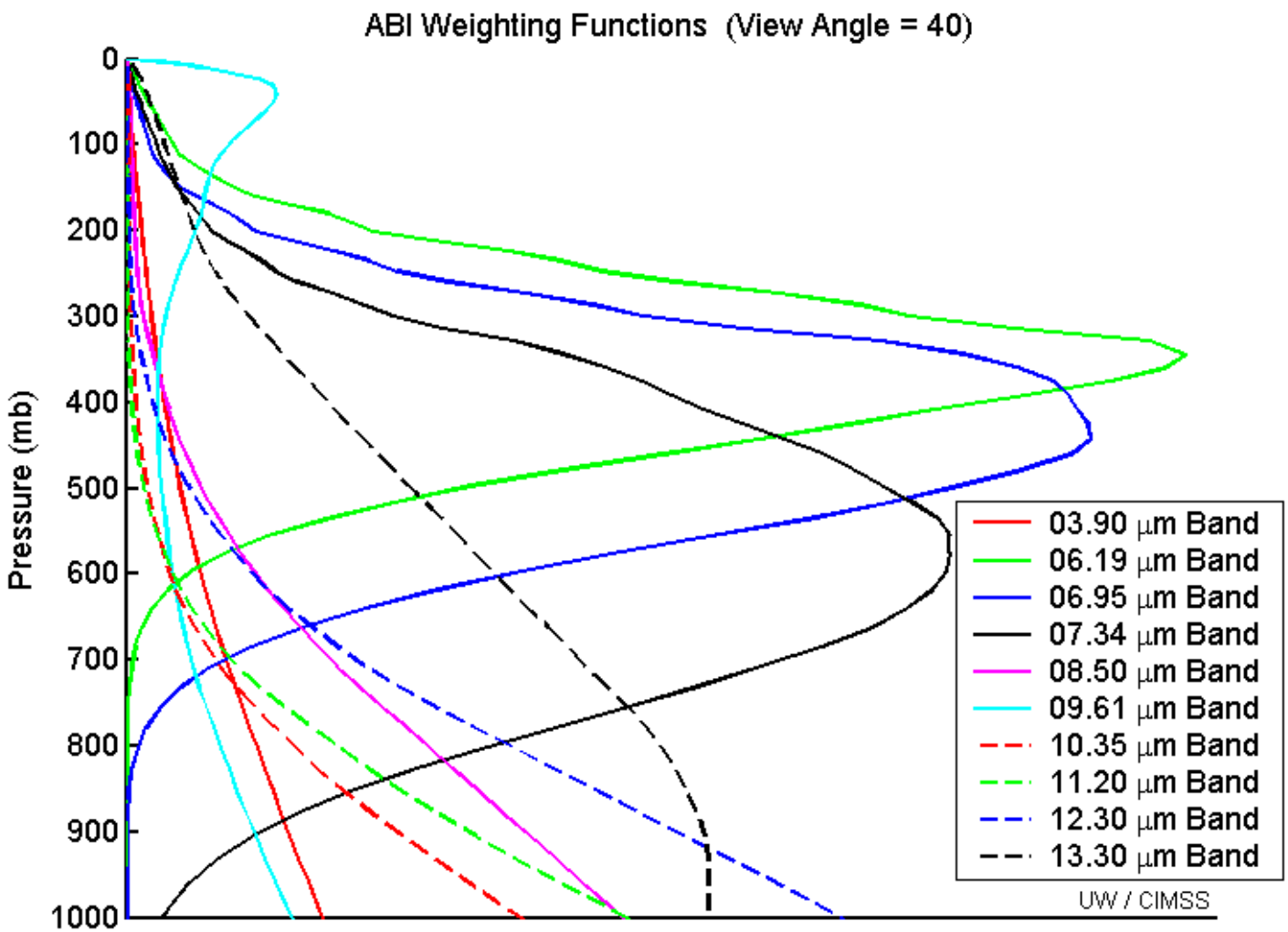
Visible and near-IR channels on the ABI



The current GOES has only one visible band.


Snow
ABI Bands
Grass
Reflectance (%)
Relative Response
Wavelength (um)
0
20
40
60
80
100
0.0
0.5
1.0
1.5
2.0
0.5
1.0
1.5
2.0
2.5

Weighting Functions for the IR channels on the ABI



Weighting functions for the standard atmosphere at a local zenith angle of 40 degrees.

ABI Bands

Future GOES Imager (ABI) Band	Wavelength Range (μm)	Central Wavelength (μm)	Sample Objective(s)
1	0.45-0.49	**0.47**	Daytime aerosol-over-land, Color imagery
2	0.59-0.69	**0.64**	Daytime clouds fog, insolation, winds
3	0.84-0.88	**0.86**	Daytime vegetation & aerosol-over-water, winds
4	1.365-1.395	**1.38**	Daytime cirrus cloud
5	1.58-1.64	**1.61**	Daytime cloud water, snow
6	2.235 - 2.285	**2.26**	Day land/cloud properties, particle size, vegetation
7	3.80-4.00	**3.90**	Sfc. & cloud/fog at night, fire
8	5.77-6.6	**6.19**	High-level atmospheric water vapor, winds, rainfall
9	6.75-7.15	**6.95**	Mid-level atmospheric water vapor, winds, rainfall
10	7.24-7.44	**7.34**	Lower-level water vapor, winds & SO_2
11	8.3-8.7	**8.5**	Total water for stability, cloud phase, dust, SO_2
12	9.42-9.8	**9.61**	Total ozone, turbulence, winds
13	10.1-10.6	**10.35**	Surface properties, low-level moisture & cloud
14	10.8-11.6	**11.2**	Total water for SST, clouds, rainfall
15	11.8-12.8	**12.3**	Total water & ash, SST
16	13.0-13.6	**13.3**	Air temp & cloud heights and amounts

Based on experience from:

Current GOES Imagers

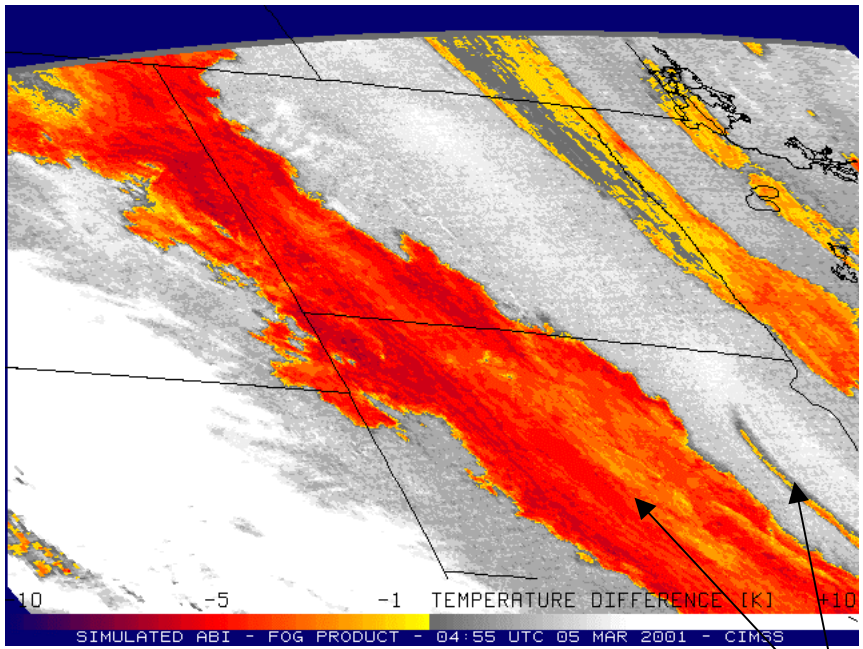
MSG/AVHRR/ Sounder(s)

MODIS, Aircraft, etc

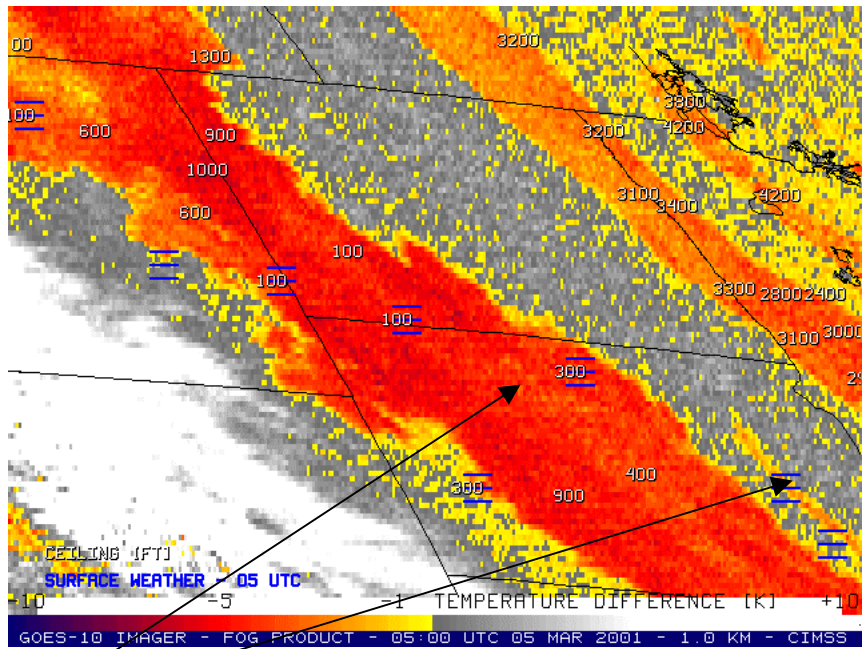
Fog -- Based on GOES Imager 3.9 µm

5 March 2001 - Nocturnal Fog/Stratus Over the Northern Plains

ABI 4 minus 11 µm Difference



GOES-10 4 minus 11 µm Difference



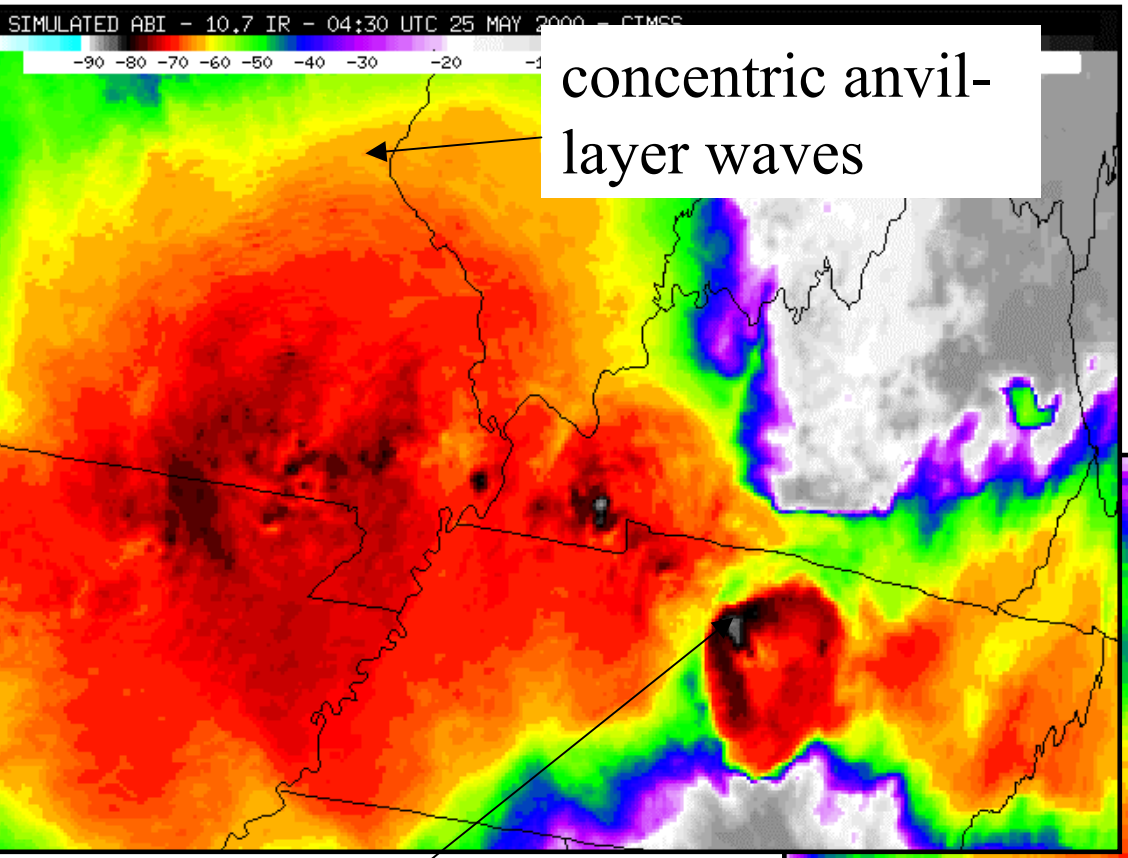
Both images are shown in the GOES projection.

Fog

UW/CIMSS

ABI image (from MODIS) shows greater detail in structure of fog.

Higher Spatial Resolution GOES Channels



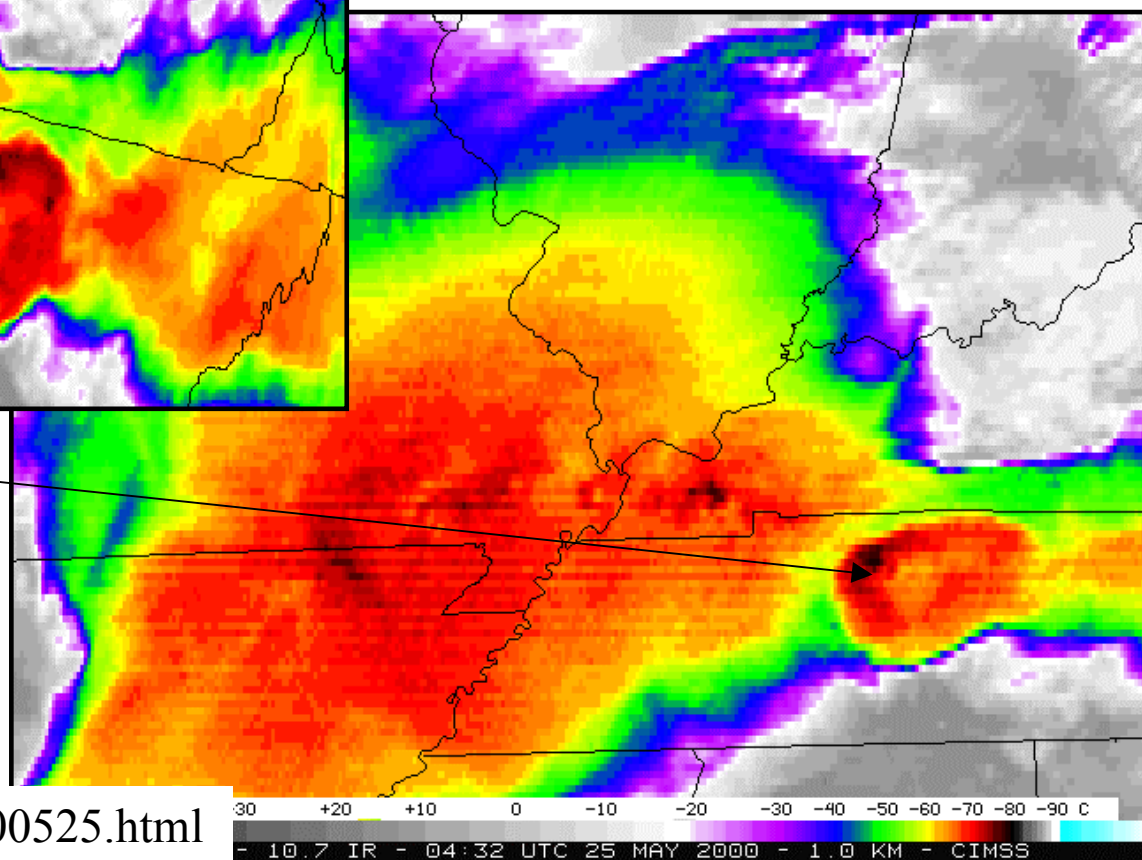
concentric anvil-layer waves

Simulated ABI (from MODIS)

Enhanced "V": IR windows May 25, 2000

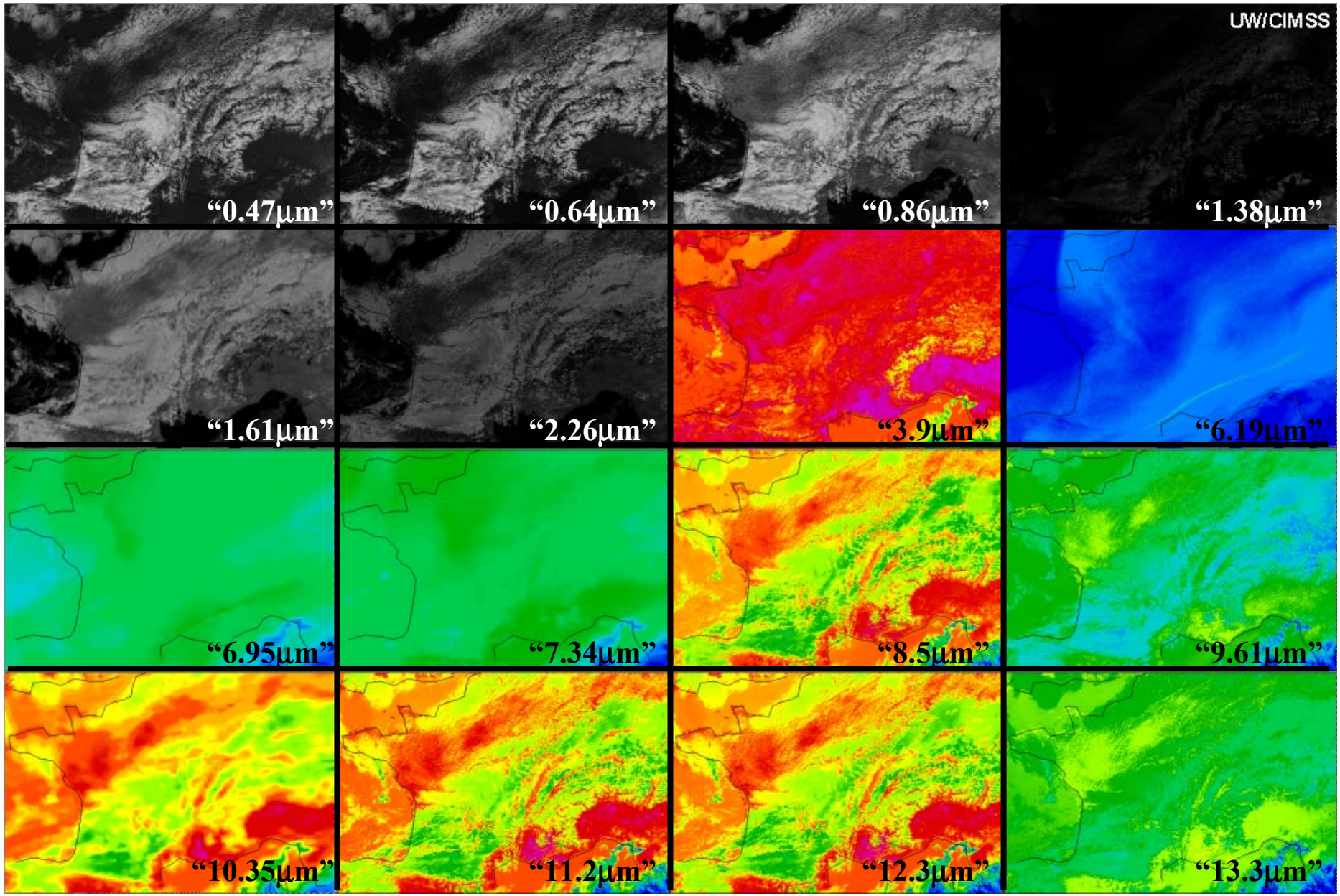
Enhanced "V"

Actual GOES

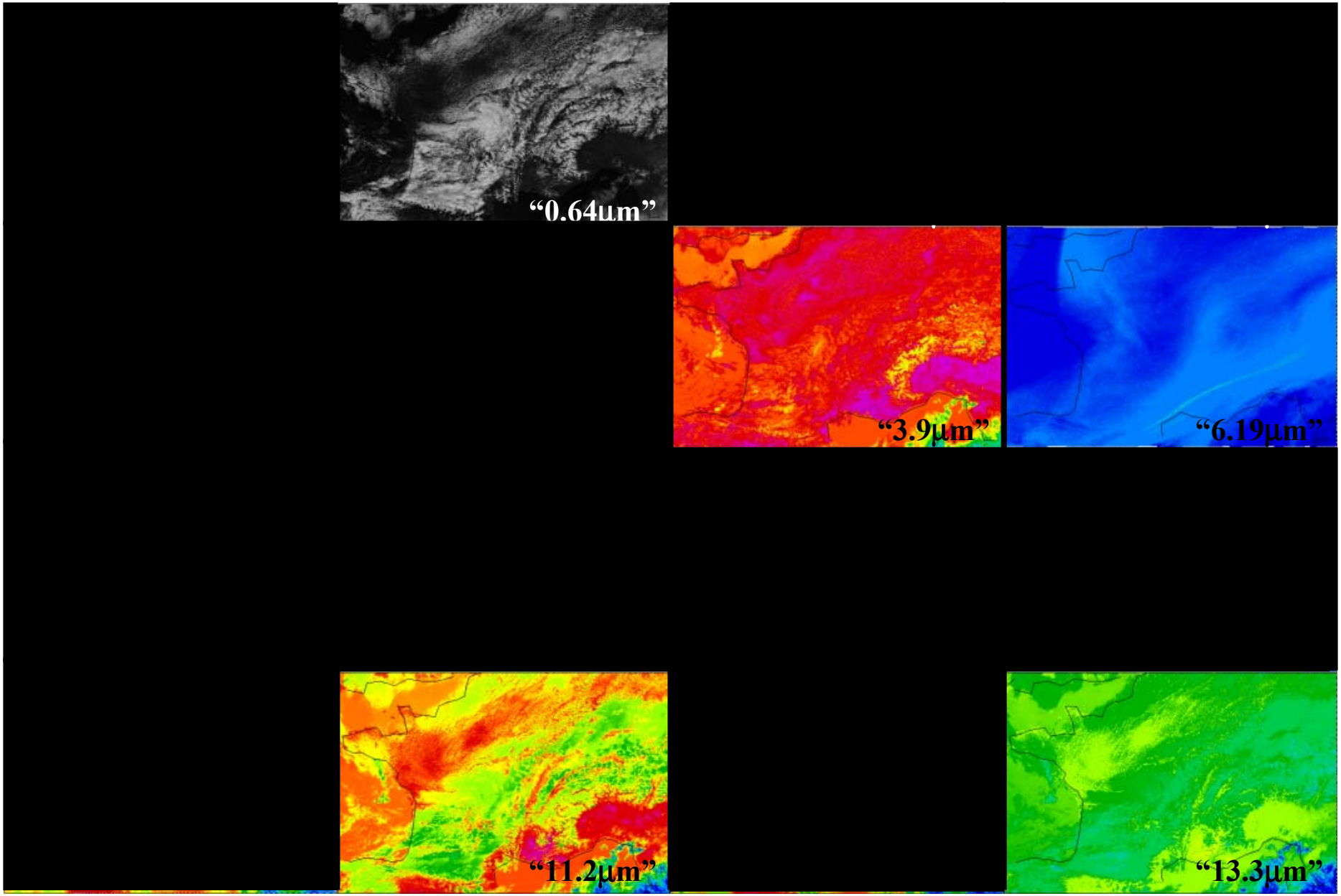


http://cimss.ssec.wisc.edu/goes/misc/000525.html

Using MODIS, MET-8 and AIRS to simulate the spectral bands on the Advanced Baseline Imager (ABI)



Similar bands on the GOES-12 Imager



HES Tasks

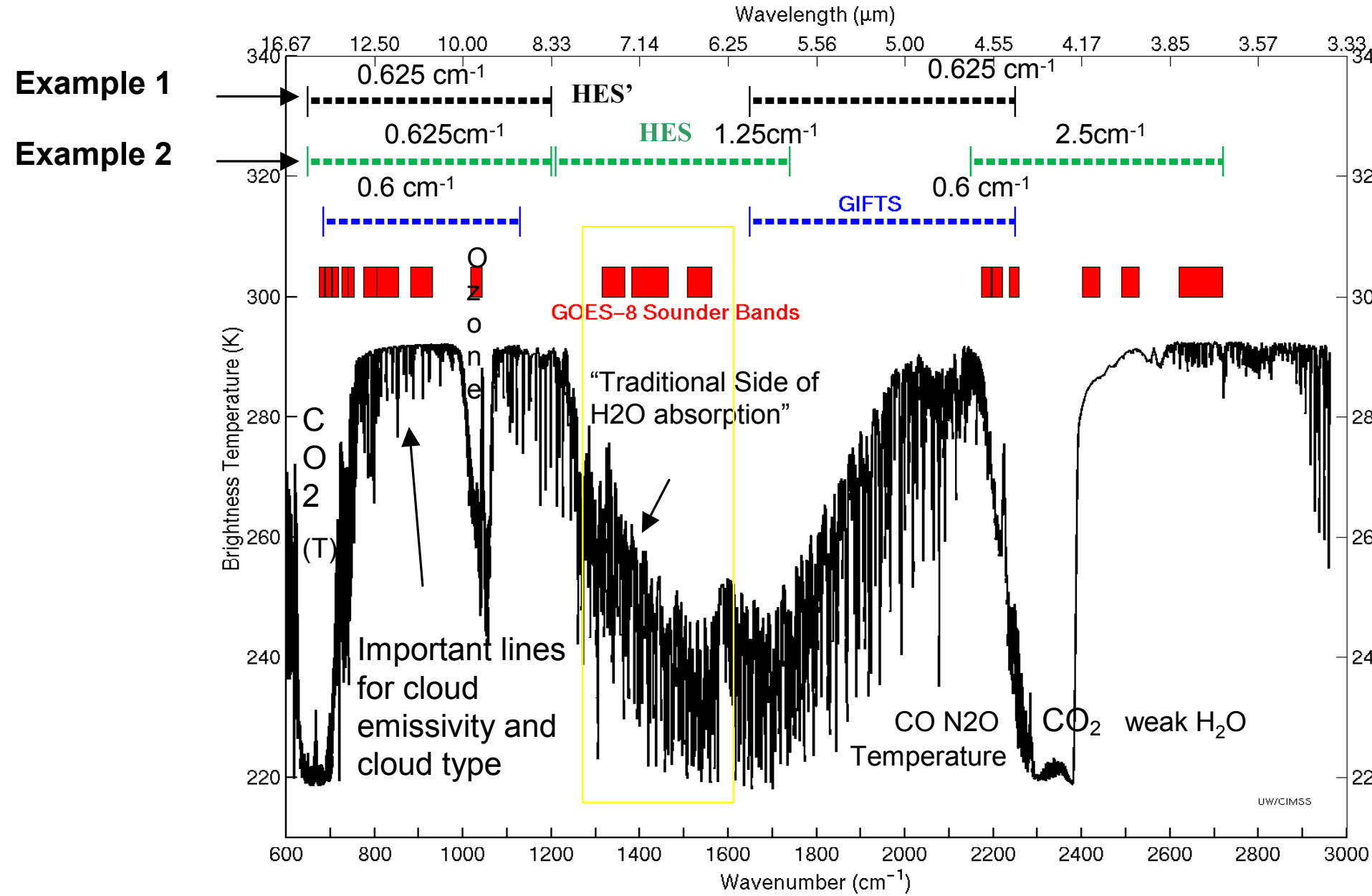
- HES - Disk Sounding (HES-DS)
  - Provide **vertical moisture and temperature information**, and **other environmental data** with 10 km footprint size, over the near full disk in one hour.

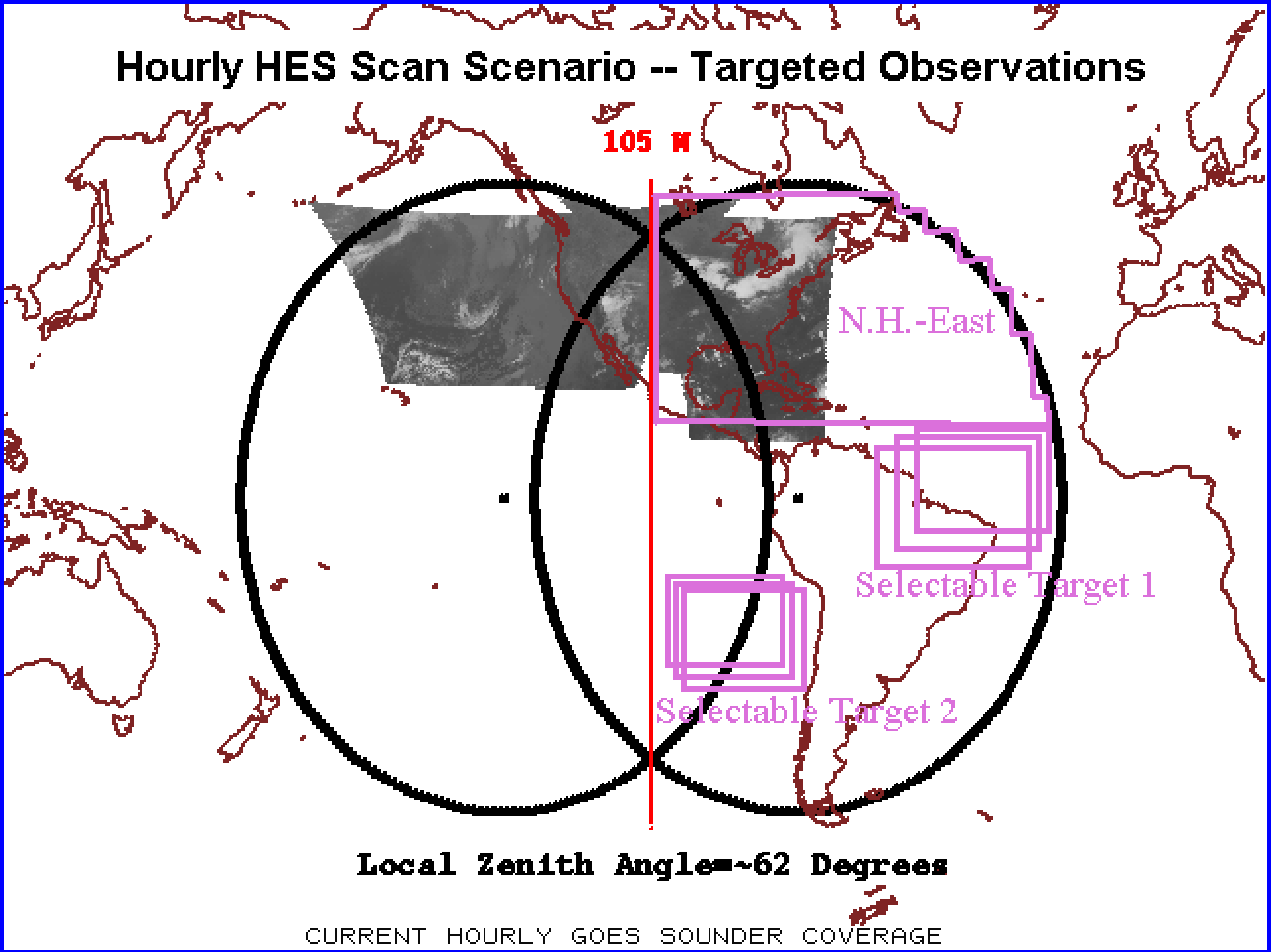
- HES - Severe Weather / Mesoscale (HES-SW/M)
  - Provide vertical moisture and temperature information and other environmental data with 4 km footprint size, over a 1000 by 1000 km area in 4 minutes.

HES Tasks

- HES – Coastal Waters Imaging
  - 14 channels from 0.40 μm to 1.0 μm
  - Coverage within 400 km of coastline every 3 hours
  - 300 m footprint size
  - Improved observation of:
    - Ocean color
    - Harmful algal blooms
    - Sediment plumes
    - Chaotic coastal zone currents

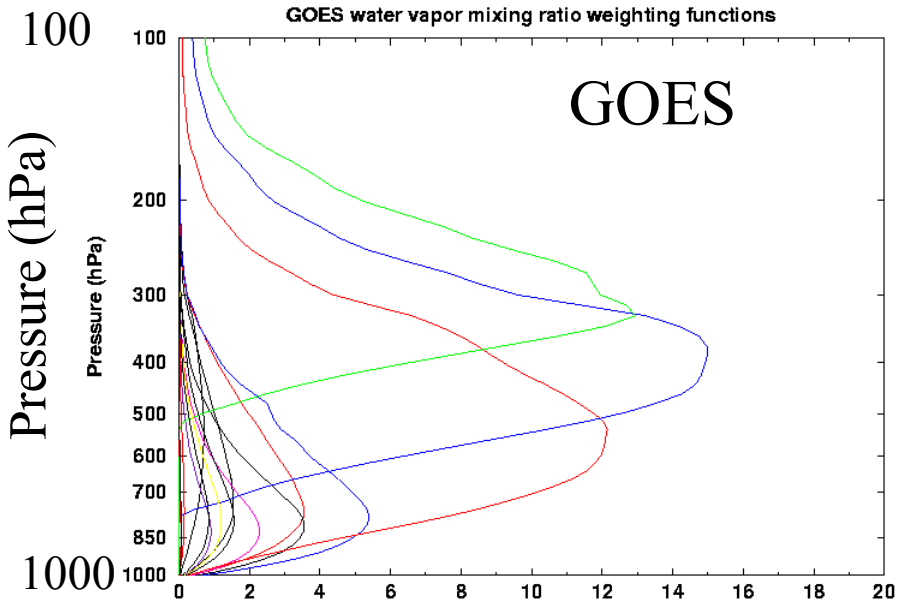
IR Spectral Coverage (DS or SW/M)

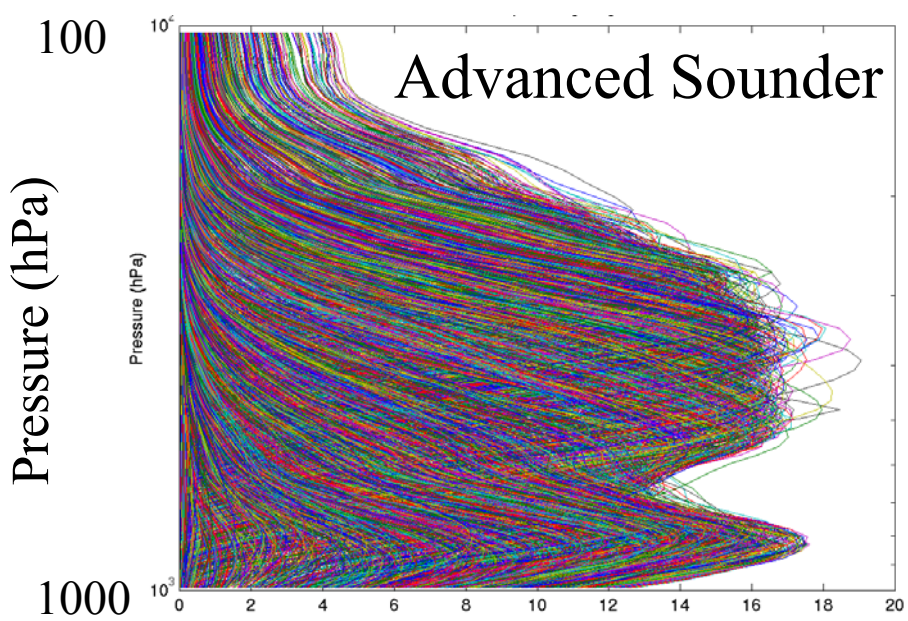



Hourly HES Scan Scenario -- Targeted Observations
105 W
N.H.-East
Selectable Target 1
Selectable Target 2
Local Zenith Angle=~62 Degrees
CURRENT HOURLY GOES SOUNDER COVERAGE

Sounder Comparison (GOES-Current to HES-Req)

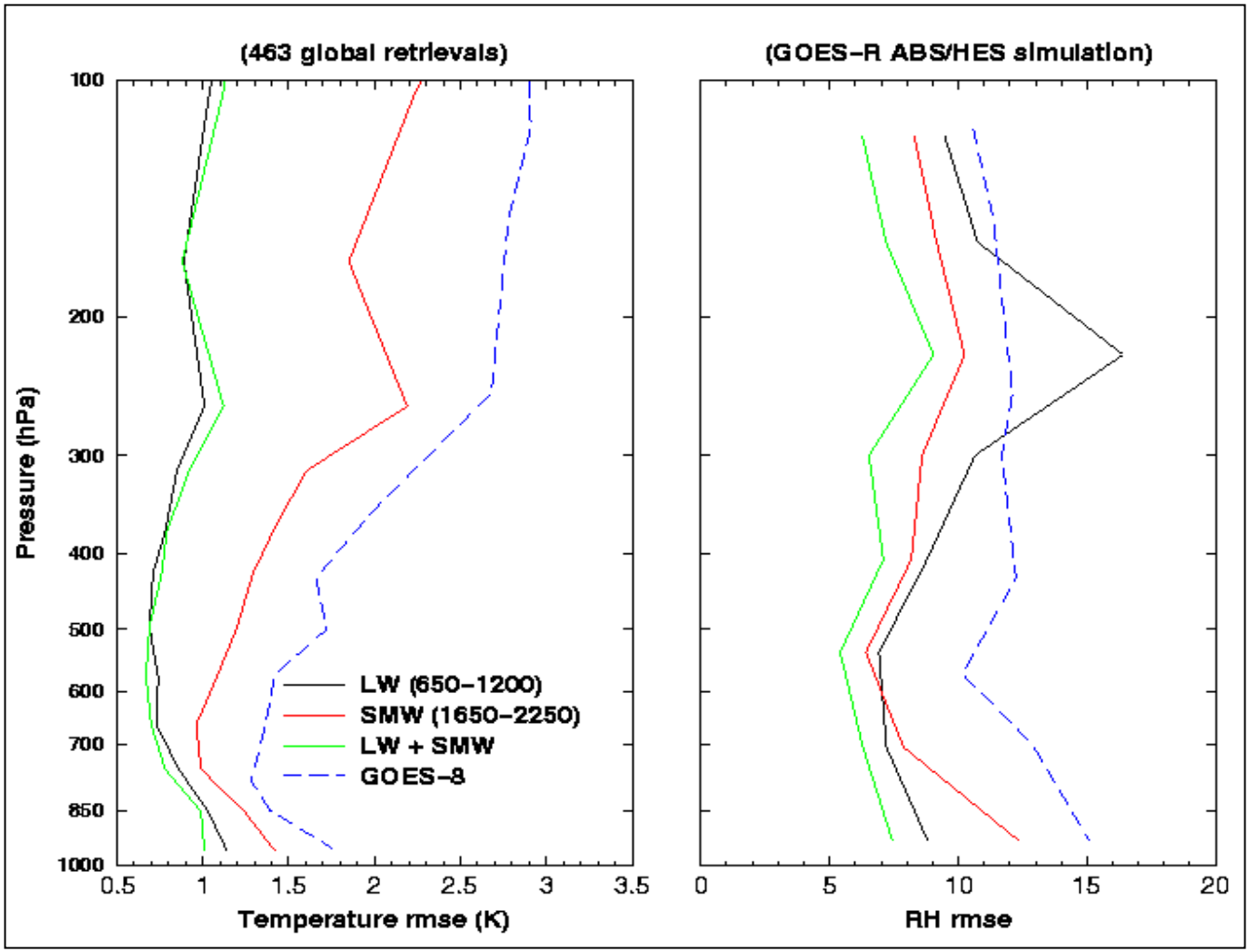
	Current	Requirement
Coverage Rate	CONUS/hr	Sounding Disk/hr
Horizontal Resolution		
-Sampling Distance	10 km	10 km
- Individual Sounding	30-50 km	10 km
Vertical resolution	~3 km	1 km
Accuracy		
Temperature	2 deg. K	1 deg. K
Relative Humidity	20%	10%





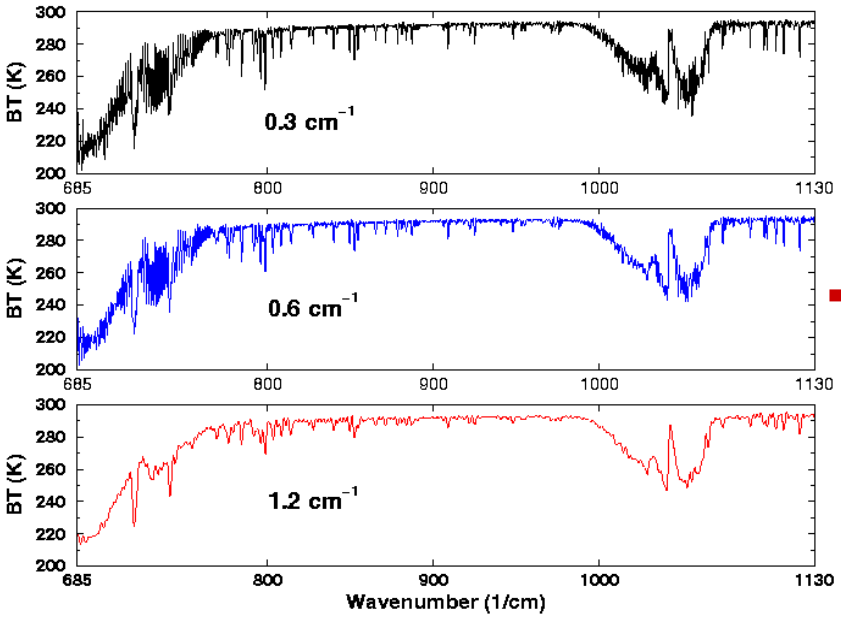
Moisture Weighting Functions

High spectral resolution advanced sounder will have more and sharper weighting functions compared to current GOES sounder. Retrievals will have better vertical resolution.

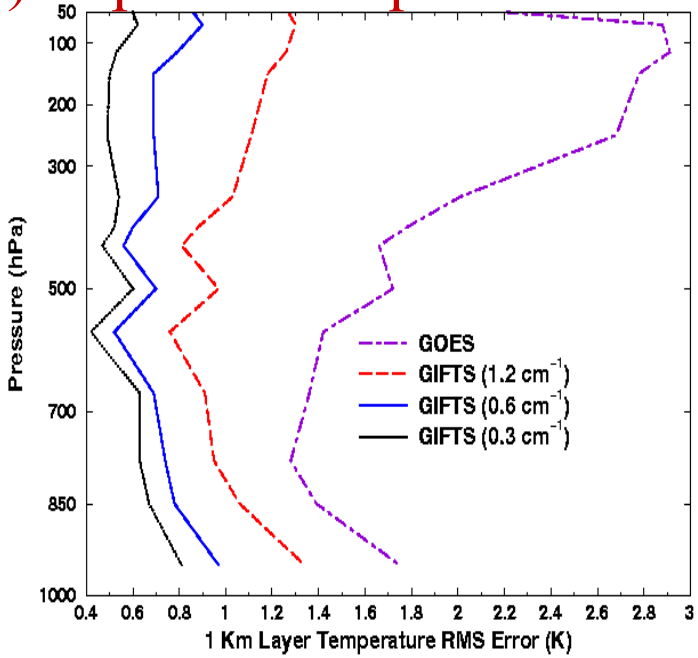


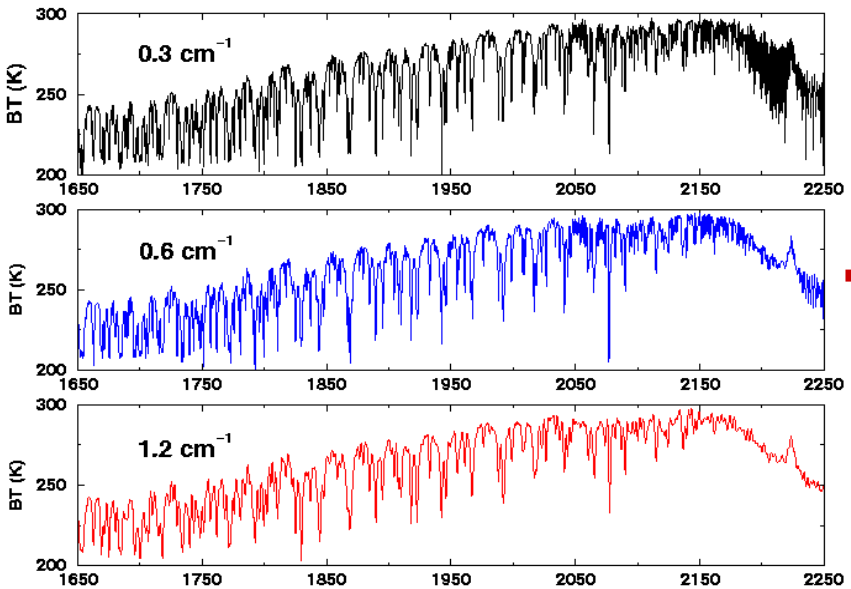
The 1km vertical temperature retrieval RMSE (left panel) and 2km vertical water vapor (RH) retrieval RMSE (right panel) from HES LW only, SMW only, LW + SMW, and current GOES sounder. 463 independent profiles distributed globally are included in the retrieval statistics; TRD noise is used in the simulation.

Spectral resolution (0.3, 0.6, 1.2 cm**-1) impact on T/q retrieval

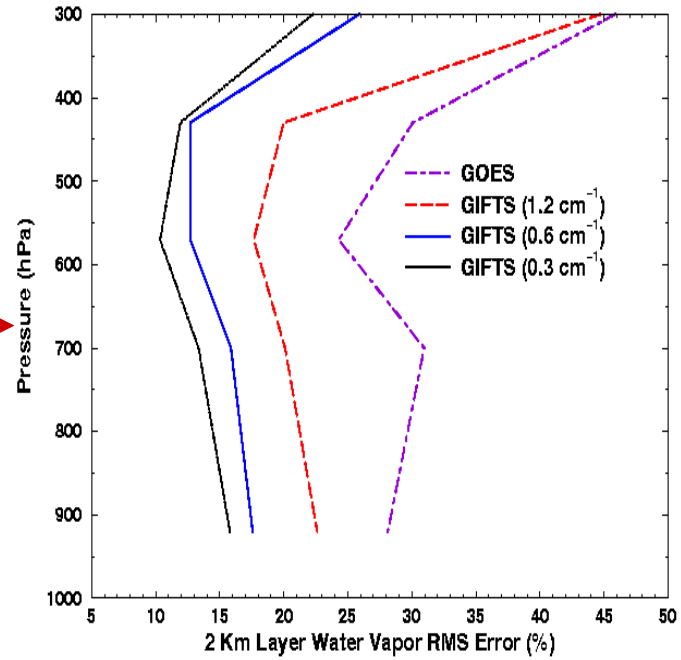


LW





MW



SIS/SEISS IMPROVEMENTS

- GOES-R Space Weather Instruments
  - Space Environmental In Situ Suite (SEISS)
    - proton, electron, and heavy ion fluxes
  - Solar Imaging Suite (SIS)
    - solar X-ray flux magnitude
    - solar EUV flux from 5 to 129 nm
    - coronal holes locations
    - solar flares
    - coronal mass ejections
  - Magnetometers

- GOES-R Improvements
  - Solar X-ray image dynamic range, resolution, and sensitivity
  - EUV measurements using 8 channels (5 channels) In improved modeling of ionosphere and thermosphere
  - Medium energy radiation environment responsible for spacecraft charging

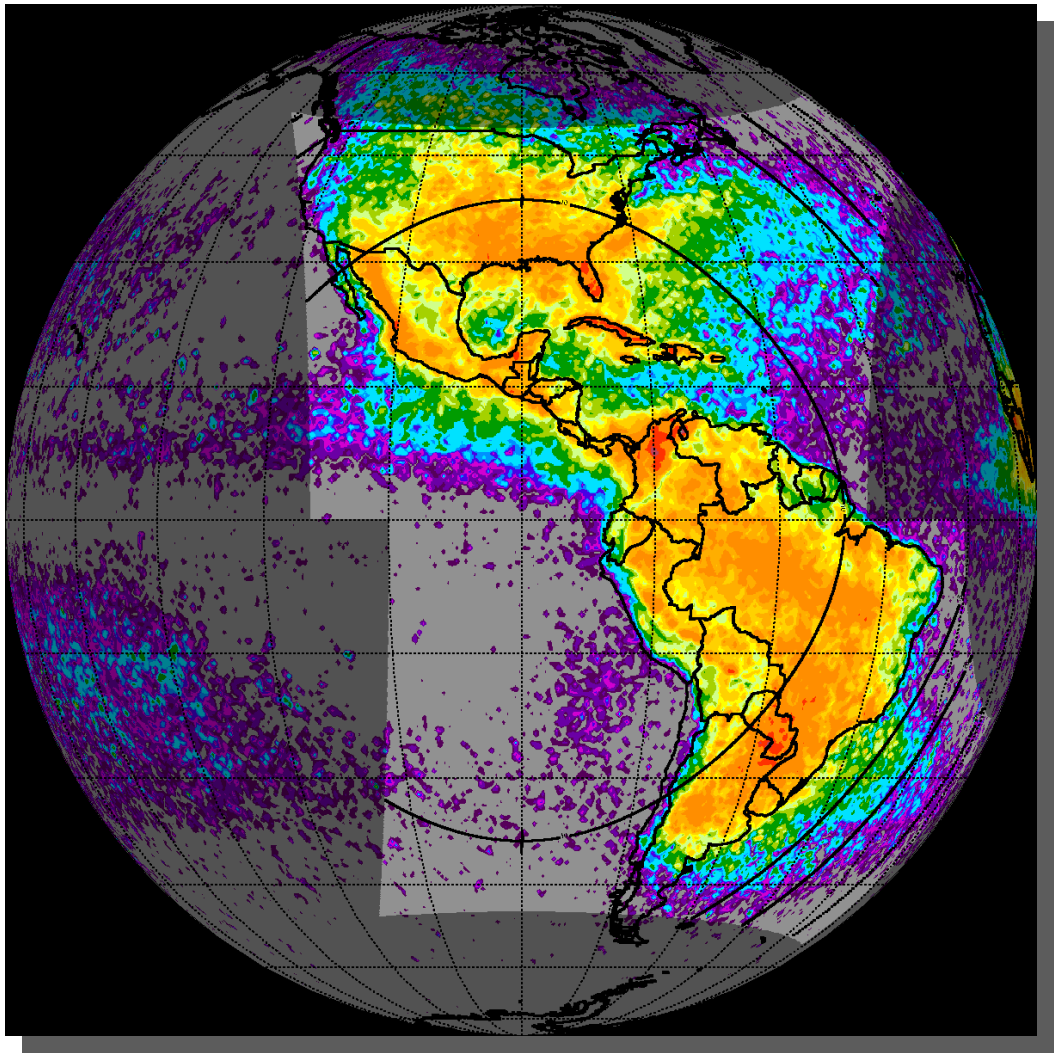
GEOSTATIONARY LIGHTNING MAPPER

- Detects Total Strikes: In Cloud, Cloud To Cloud, And Cloud To Ground
  - Compliments Today's Land Based Systems That Only Measures Cloud To Ground (About 15% Of The Total Lightning)
- Increased Coverage Over Oceans And Lands
  - Currently No Ocean Coverage, And
  - Limited Land Coverage In Dead Zones
- Parameters
  - Hemispheric Or CONUS Coverage
  - 10 Km Spatial Resolution (1 Km Goal)

Lightning Sensing from GEO

- Climate Monitoring
- Storm Development
- Ice-phase precipitation estimates
- Severe Weather Now-casting
- Data assimilation and model inputs
- Atmospheric chemistry

GEO



User Services

User Services on current GOES satellites, including the **Data Collection System** (DCS), the **Low Rate Information Transmission** (LRIT), and **Search and Rescue** (SAR) will continue through the GOES-R Series.

The GOES **DCS** is a communications relay system that handles information gathered by remotely located Data Collection Platforms (DCPs)

Summary

The great amount of information from the GOES-R series will offer not only a continuation of current products and services, but also vastly improved or new capabilities.

These products, based on validated requirements, will cover a wide range of phenomena. This includes applications relating to: weather, climate, ocean, coastal zones, land, hazards, solar and space.

The Advanced Baseline Imager (ABI), the Hyperspectral Environmental Suite (HES), the Geo Lightning Mapper (GLM), the space and solar instrument suites (Solar Imaging Suite (SIS), Space Environment In-Situ Suite (SEISS) and the user services on GOES-R will enable much improved monitoring compared to current capabilities.

More information -- ABI

ABI Research Home page (with a link to all these links):

- http://cimss.ssec.wisc.edu/goes/abi/

ABI Simulated images from NASA AIRS Direct Broadcast:

- http://cimss.ssec.wisc.edu/goes/abi/airs_broadcast/aniairs.html

GOES and MODIS Galleries:

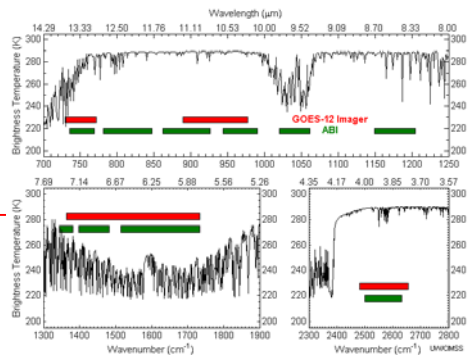
- http://cimss.ssec.wisc.edu/goes/misc/interesting_images.html
- http://terra.ssec.wisc.edu/~gumley/images.html

ABI Documentation from NASA:

- http://goes2.gsfc.nasa.gov/abihome.htm

ABI Simulated Spectral Response functions:

- ftp://ftp.ssec.wisc.edu/ABI/SRF



NASA's (draft) HES PORD (**PERFORMANCE AND OPERATION REQUIREMENTS DOCUMENT**):
http://goes2.gsfc.nasa.gov/HEShome.htm

Industry Day briefings:
http://goes2.gsfc.nasa.gov/goesr_industry.htm

CIMSS page:
http://cimss.ssec.wisc.edu/goes/hes/

The GOES-R Users Conference
http://www.osd.noaa.gov

ftp://ftp.osd.noaa.gov/Goes-R/

Architecture study web page:
http://www.osd.noaa.gov/goesr_arch_study/info/tech_docs.htm